A New Approach to Data Management: Design and Implementation of Database Modules for the DC Field Facility

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Abstract
For many scientific operations at the MagLab, it is necessary to store large amounts of data into one accessible application where users can edit, search, graph, save, and export information. Using Filemaker Pro 15, two database projects were initiated in order to fulfill this need for better data visualization and documentation: the Facility Operations Database and the DC Field Operations Task Management Database.

Facility Operations Database
Overview:
The Facility Operations Database has the following components:
- Water Treatment Data
- Monday checks
- Weekly forklift checks
- Scissor lift updates

Other features include:
- User guide
- Individual accounts
- List of employees with active accounts and contact information
- LSI (Langelier Saturation Index) calculator for water treatment
- Automated fields when creating new data logs (e.g. date and name of current user)

Water treatment is the primary focus of this database. Three times a week, employees:
1. Walk down the water treatment plant
2. Perform treatment measurements
3. Manually enter values into the database

With the measurements now accessible on the new database, users can:
- Edit, search, graph, save, and email data
- Print treatment logs, graphs, and spreadsheets

Graphs help workers to:
- View trends
- Compare related water treatment details
- Compare measurements with the accepted range of values for that detail

Behind the Scenes: Calculations, Layout Design, and Account Privileges

- The LSI Calculator
The LSI calculator takes three parameters (pH of cooling water, m-alkalinity, and calcium) and calculates the LSI number using Langelier’s Calculation. The user must manually enter these values into the database. The variables C and D are calculated using the table below.

<table>
<thead>
<tr>
<th>Calcium Hardness</th>
<th>CO3</th>
<th>H+ Alkalinity</th>
<th>CO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/Mo</td>
<td>10-11</td>
<td>12-13</td>
<td>14-15</td>
</tr>
<tr>
<td>5</td>
<td>10-11</td>
<td>12-13</td>
<td>14-15</td>
</tr>
</tbody>
</table>

Langelier’s Calculation (at NHMFL)

\[ LSI = \text{pH} - \left[ \frac{11.2 - (C + D)}{2.5} \right] \]

Example:
The pH of cooling water = 8.2
Calcium Hardness = 440 \rightarrow C = 2.3
M-Alkalinity = 300 \rightarrow D = 2.5

\[ LSI = 8.2 - \left( \frac{11.2 - (2.3 + 2.5)}{2.5} \right) = 1.8 \]

- Layouts
Using Filemaker Pro’s iOS designing tools, each layout was redesigned to fit iPad and iPhone screens. Each script was also modified to recognize the device being used and display the appropriate layout.

- Accounts
To insure data security, there is a hierarchy of accounts with special access privileges:
1. Administrator account – has access to all elements of the database except for layout design and script modifications. The Administrator account can delete records and accounts and can reset a user’s forgotten password.
2. Worker Account – has data-entry only privileges. Workers cannot delete data logs or another user’s account.
3. Guest Account – has read-only privileges. Guests only have the ability to create their own account.

DC Field Operations Task Management Database
Overview:
- This database will allow employees to enter status updates for equipment and systems across the DC Field Facility.
- The DC Field Facility building map (bottom left) and the task management database (bottom right) both illustrate the physical building layout of the magnet cells, transformer rooms, power supply rooms, instrument storage, and the cryogenics lab.

Future Work
New features will include:
- Conditional color formatting for certain layout objects and buttons (e.g., red for technical issues and green for issues that have been resolved)
- Record archiving
- Status update abilities for transformer rooms, power supply rooms, instrument storage, and the cryogenics plant
- A messaging system to allow communication with Slack (a messaging app regularly used by workers across the facility)

Conclusions
The Facility Operations Database is a big step forward from the original paper archiving method. It stores large amounts of data into one location, provides multiple resources for data manipulation and mobility and offers an LSI calculator to make record documentation more efficient. The DC Field Operations Task Management Database will provide a visual perspective of the DC field facility, the problems it may be experiencing, where these problems are located and will enable users to build statistics on trends and failure modes.

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